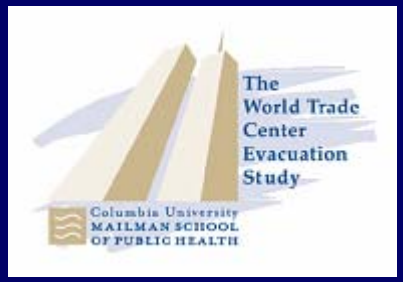

MAILMAN SCHOOL
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WTC Evacuation Study

NIST Meeting: Building Occupant Movement During Fire Emergencies

June 10, 2004

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CDC
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CPHP

Center for Public Health Preparedness
Columbia University

NCDP

National Center for Disaster Preparedness
Columbia University

ASPH
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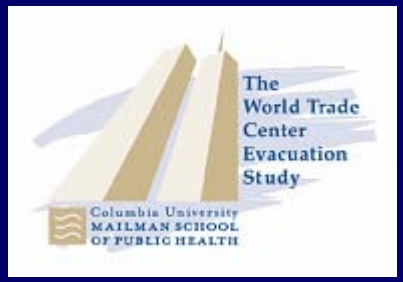
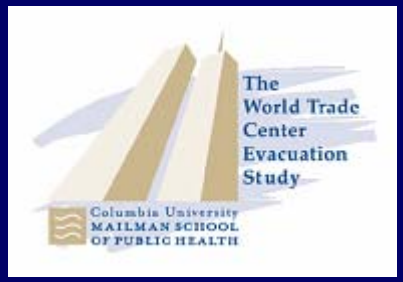


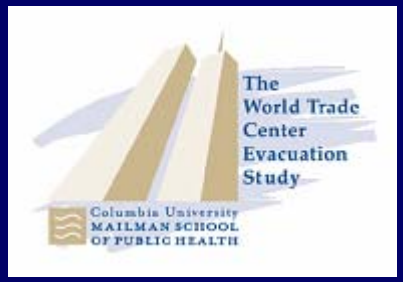
Presentation Outline

- Study goals
- Preliminary qualitative data findings
- Preliminary policy implications



Goals

1. To identify the individual, organizational, and structural factors that affected evacuation from the WTC on 9/11/01
2. To inform policy and practice in order to improve the safe evacuation of high rise structures



Considerations

- **Do occupants in high rise emergencies behave in ways that are similar to non-high rise occupants?**
- **Do emergency preparedness plans (other than evacuation plans) differ for high rise vs low rise buildings?**

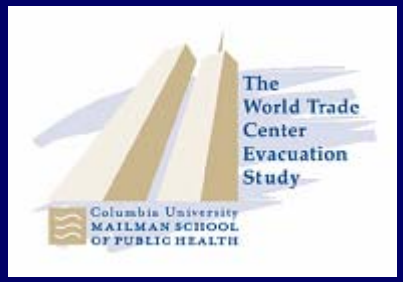
Grid

Behaviors the same?

Planning the same?	Yes	No
Yes		
No		

Implications of the Grid

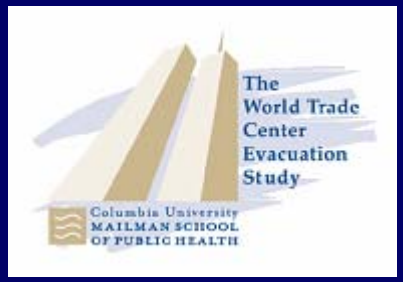
- If the behavior is the same as non-high rise emergencies, does it have utility in a high rise situation? If not, can the behavior be changed?
- If the planning is the same as for occupants of low-rise buildings, is it effective? If not, can it be changed?



Human Behaviors in Fire Emergencies

What is Known:

- **Will generally not go towards smoke**
- **Seek out groups, group size is important**
- **Move towards and stay with group even if it is not the best option**
- **Individual and group panic dependent on several key factors**
- **Information serves as motivator**



Human Behaviors in Fire Emergencies

<u>What is Known</u>:

- **Familiarity is adaptive and leads to pro-social behaviors**
- **Social contact neutralizes threat**
- **Lack of leader, ambiguity leads to milling behaviors**
- **Evacuation behaviors related to prior experience and practice- “auto-pilot”**

The World Trade Center Evacuation Study

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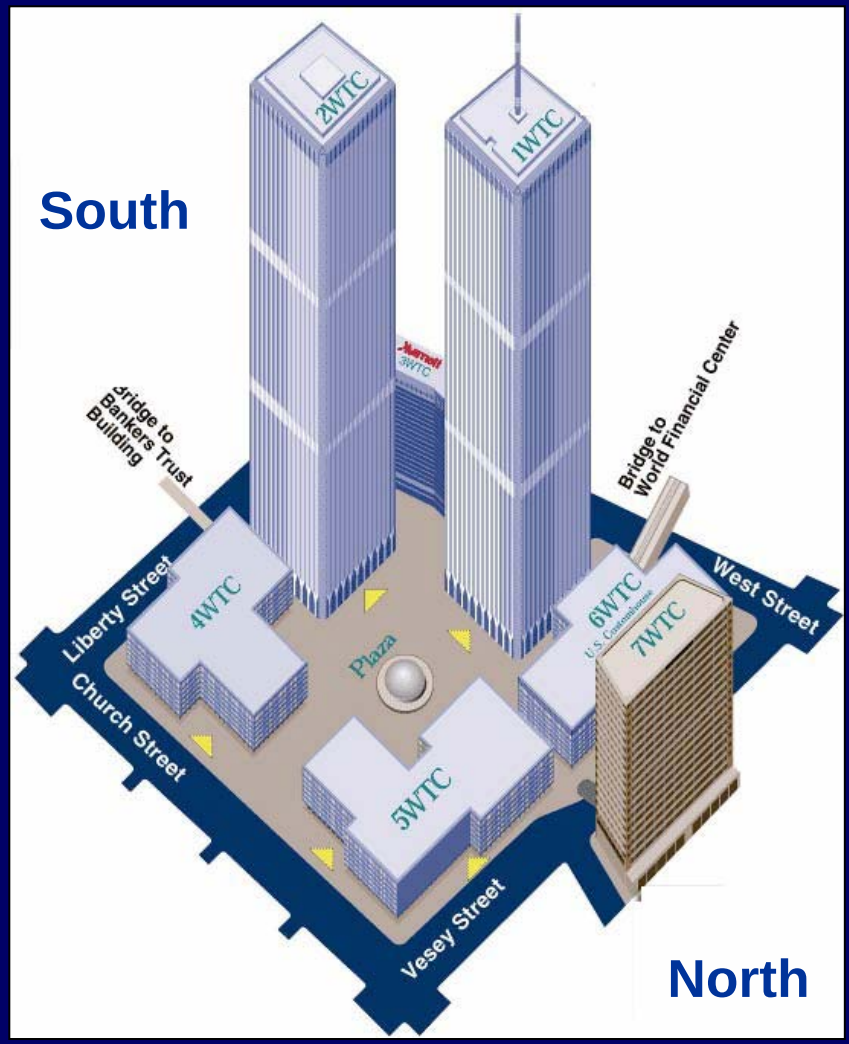
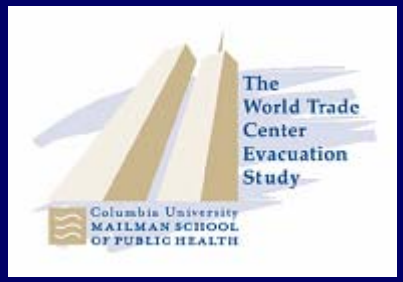
WTC Complex

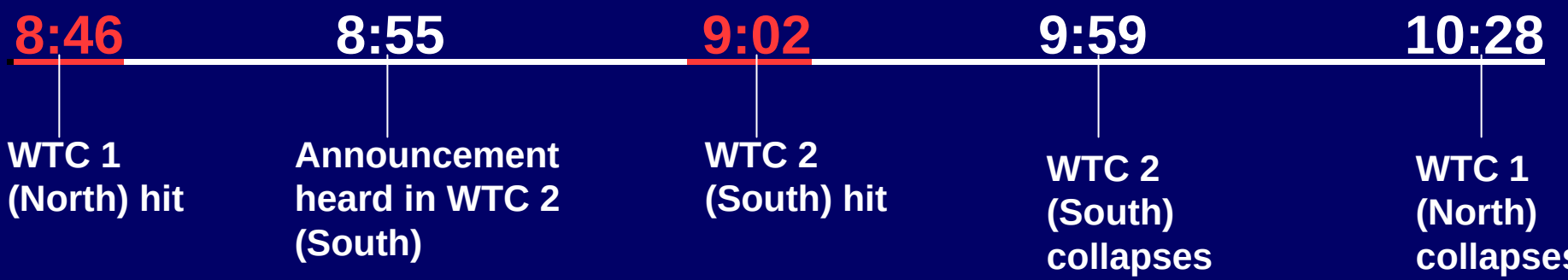


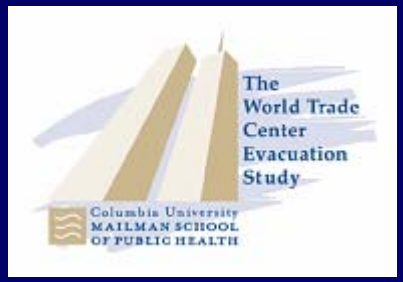


Emergency Planning for WTC

- Improved after 1993 bombing
- Defend in place strategy
- Training similar as for other buildings- regardless of size or height
- Attempts to upgrade preparedness
- Mortality would have increased dramatically had WTC 1 and 2 been fully occupied

Timeline of Events

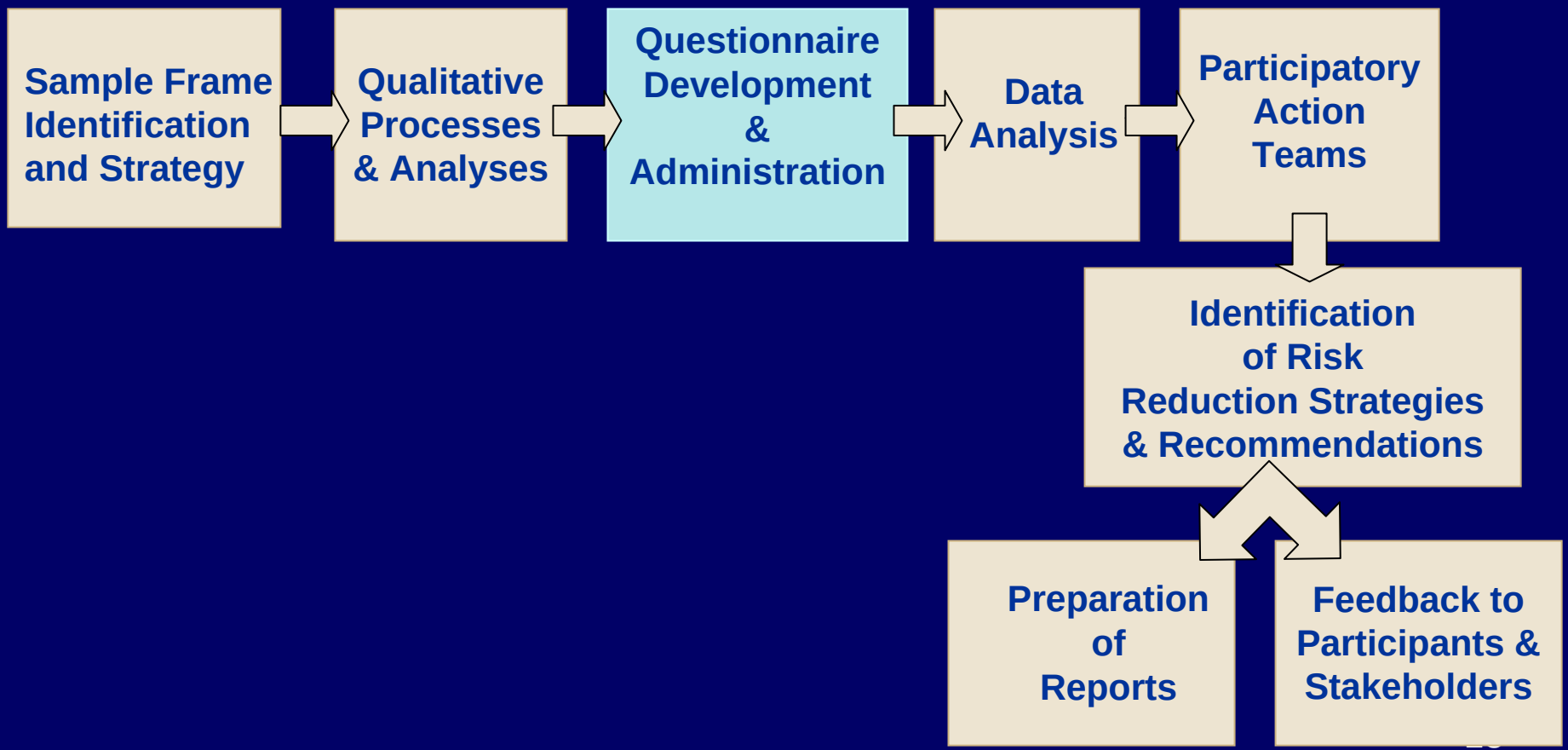


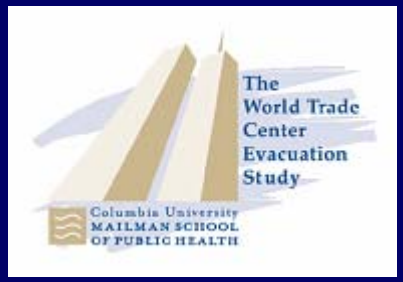


Key Decision Making Points

1. Immediately after first and second impacts
2. Initiating movement
3. Choosing stairwell
4. Maintaining movement on stairwell
5. Deciding where to exit stairwell to reach ground level
6. Deciding which exit to use at ground level
7. Initiating movement from immediate area
8. Maintaining movement at ground level

Study Overview

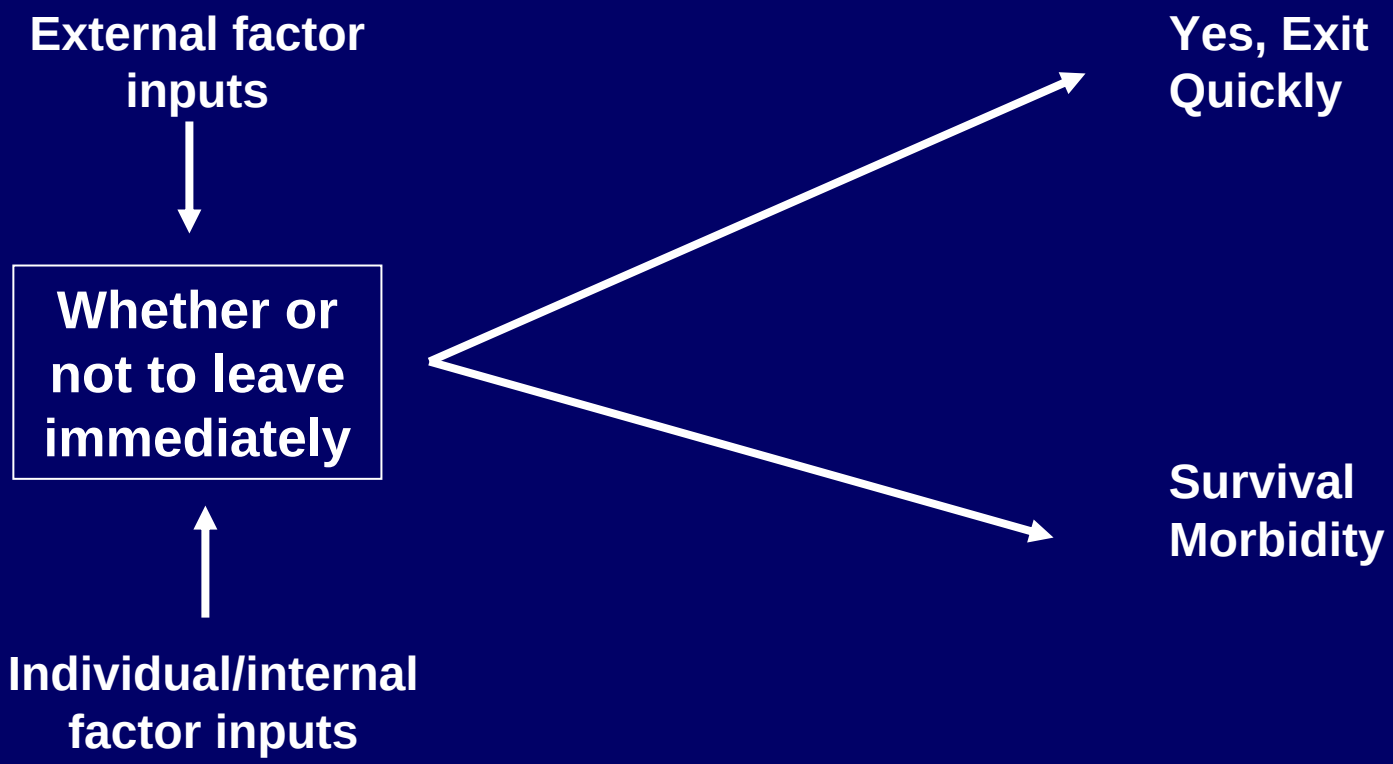




Qualitative Data

- Key Informant Interviews
- In-depth Interviews
- Focus Groups

Factors that influenced Decision-Making



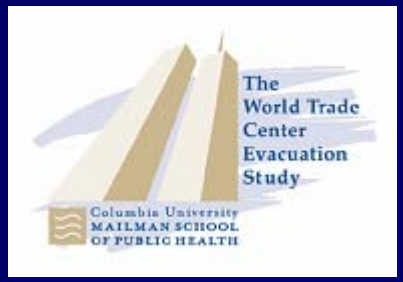
Factors Associated with Evacuation

Individual Barriers:

- Disabilities and poor physical condition
- Last minute work-related tasks
- Taking personal items, making calls
- Footwear
- Waiting for instructions/direction
- Poor familiarity with WTC building
- Fear of negative impact on job

Individual Facilitators:

- Direct evidence of magnitude
- Intuition
- Prior experience
- Familiarity with exits



Factors Associated with Evacuation

Organizational Barriers:

- Lack of internal communication
- Confusion re: fire safety responsibility
- Lack of preplanning for disabled
- Variability in training
- Poor commitment to safety climate
- Lack of orientation to building
- Lack of visitor planning
- Lack of direction on street
- Subway level mismanagement
- Breakdown in Fire Safety procedures
- Lack of info on building egress point limits

Organizational Facilitators:

- Fire drill participation
- Support from senior management
- Fire safety procedures in addition to PANYNJ

Factors Associated with Evacuation

Structural Barriers:

- Poor visibility of exit signs
- Lack of back-up communication systems
- Elevator communication
- Locked egress (re-entry points)
- Stairwell width
- Stairwell design (e.g., switching)
- Debris/water/smoke

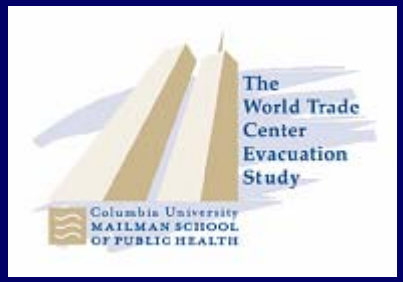
Structural Facilitators:

- Well lit stairwells

Grid

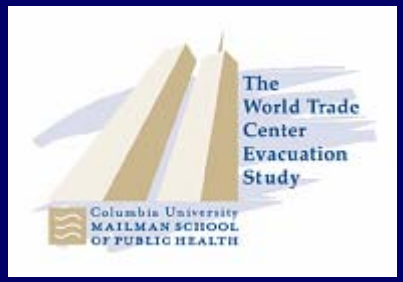
Behaviors the same?

Planning the same?	Yes	No
Yes	+	–
No	–	–



Recommendations from a human behavioral perspective

- Familiarize with other occupants
- Participate in drills
- Obtain as much information as feasible
- Pre-identify group
- Be prepared to take leadership role if necessary



Recommendations from the Planning Perspective

- Plans should reflect magnitude of event- both defend in place and full evacuation

- Plans should include mechanisms to effect rapid full building evacuation- if needed

Preliminary Recommendations

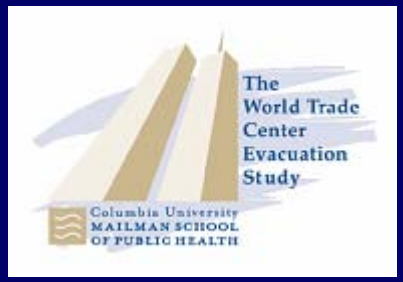
Individual:

- Degree of personal responsibility
- Familiarity with building, especially exit points
- Determine time to descend
- Disability preparations
- Comfortable footwear
- Start evacuation immediately

Preliminary Recommendations

Organizational:

- Delineation of responsibilities
- Written plans, policies that target full evacuation if necessary
- Training, mandatory, new, annual, and orientation
- Drills to include stairwells, 3 flight minimum
- Leaders chosen with experience
- Responsibilities of building owners, lease holders, employers and employees
- Coordination/pre-planning with local agencies
- Prioritize safety climate- senior level support



Preliminary Recommendations

Structural:

- Redundancy of communication systems
- Communication in elevators
- Signage
- Lighting
- Egress- wider stairs

Phase III: Questionnaire Development & Administration

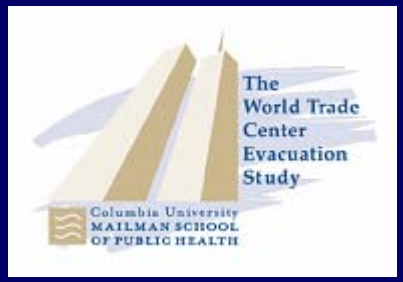
- Security badge list from Port Authority of NY/NJ in December 2003
- ~100,000 employees in WTC 1, 2, 7
- Current as of April 2001
- Excel spreadsheet file
  - Names
  - Employer Names
  - Tower
  - Floor
  - WTC phone #
  - Badge type (permanent employee, contractor, PANYNJ employee)

Questionnaire continued

- **Sample underwent "cleaning"**
  - **WTC 7 employees removed**
  - **Names of deceased removed (checked 3x)**
  - **Duplicate entries removed**
- **30,000 sampling frame (randomly selected)**
  - **20,000 randomly selected from sample to receive recruitment letter**

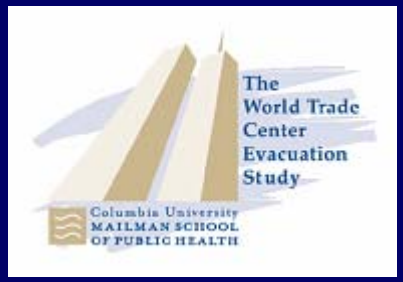
Questionnaire: Process

- **Hard copy, web-based, and email versions**
- **Recruitment letter w/ return post card**
  - Accept/decline
  - In WTC 1 or 2 on 9/11
  - Bar code
  - Web based or paper version option (mailed or emailed)
  - Code # serves as web based user ID
- **After 2 weeks, no card or web completion → first reminder card**
- **Three month data collection phase**



Preliminary Recommendations

- High rise occupancies → High risk occupancies
- Inform:
  - Building owners, leaseholders, employees
  - Code development
  - Building design
  - Regulatory compliance
  - Emergency planners
- Next Steps:
  - Develop and evaluate model evacuation plan
  - Meet with OSHA, WTC builders
  - Widespread dissemination to reach all stakeholders



World Trade Center Evacuation Study

http://cpmcnet.columbia.edu/dept/sph/CPHP/wtc.html